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Abstract

Introduction

Bariatric surgery can facilitate weight loss and improvement in medical co-morbidities. It has a profound impact on nutrition and patients need access to follow-up and aftercare. NICE CG189 Obesity emphasised the importance of a minimum of two years follow-up in the bariatric surgical service and recommended that following discharge from the surgical service, there should be annual monitoring as part of a shared care model of chronic disease management.

Methods

NHS England Obesity Clinical Reference Group commissioned a multi-professional subgroup, which included patient representatives, to develop bariatric surgery follow-up guidelines. Terms of reference and scope were agreed. The group members took responsibility for different sections of the guidelines depending on their areas of expertise and experience. The quality of the evidence was rated and strength graded.

Results

Four different shared care models were proposed taking into account of variation in access to bariatric surgical services and specialist teams across the country. The common features include annual review, ability for GP to refer back to specialist centre, submission of follow-up data to the national data base to NBSR.

Conclusion

Clinical commissioning groups need to ensure that a shared care model is implemented as patient safety and long term follow-up are important.

Guidelines for the follow-up of patients undergoing bariatric surgery

Introduction

Bariatric surgery is a recognised treatment option for patients with clinically severe obesity. For some patients, it is an effective tool in combination with dietary, behavioural and lifestyle changes in facilitating weight loss and improvement in medical co-morbidities. The UK National Bariatric Surgery Registry (NBSR 2014) reported that between 2011 to 2013, 32,073 bariatric surgery operations were performed of which 76.2% were funded by the NHS (1). These included gastric band, gastric bypass, sleeve gastrectomy and duodenal switch. One year following surgery, in addition to achieving a clinically significant weight loss, 64% of the patients with preoperative functional impairment could climb three flights of stairs without resting and 61% of patients who had sleep apnoea could stop treatment. Two years after surgery, 65.1% of patients with type 2 diabetes who had been able to stop hypoglycaemic medication after surgery had not yet needed to restart.

The NCEPOD report Too Lean a Service (2012) was critical of the initial post-operative care and made a number of recommendations (2). These included ensuring that the patient received clear post-operative dietary guidance; the General Practitioner (GP) received a timely discharge summary and plan and there was a clear, continuous long term follow-up plan involving all the appropriate health care professionals.

The NICE Clinical Guideline 189 “Obesity: identification, assessment and management of overweight and obesity in children, young people and adults” emphasised the importance of regular post-operative follow-up with a minimum of two years in the bariatric surgical service (3). It was recommended that this follow-up should include dietary and nutritional assessment, advice and support; nutritional monitoring; review of co-morbidities and medications; physical activity advice and support and individualised psychological support. It also stated that following discharge from the bariatric surgical service, “there should be at least annual monitoring of nutritional status and appropriate supplementation according to need following bariatric surgery, as part of a shared care model of chronic disease management”. Currently there is no mechanism as to how this should be implemented and there are concerns raised by some GPs with respect to their expertise, facilities and resources to do this.

Bariatric surgery has profound effects on dietary and nutritional intake with some procedures affecting the absorption of micronutrients (4-11). There is a serious risk of malnutrition if the patient is unable to comply with the nutritional guidelines, follow-up and aftercare. Patients may be at risk of protein malnutrition. Although the risk of protein malabsorption is more commonly associated with malabsorptive surgical procedures such as the duodenal switch and the distal gastric bypass, health care professionals should be aware that all post-operative patients are at risk of developing primary protein malnutrition because of poor protein intake. Factors affecting the quality of oral diet and nutrition include an overtight gastric band, anastomotic stricture, fear of weight regain,

anorexia, vomiting or non-compliance with dietary advice (12). The incidence of iron deficiency anaemia and vitamin B12 deficiency is increased following gastric bypass, sleeve gastrectomy and duodenal switch (7-11). Vitamin D deficiency is common in the obese population and the risk increases following bariatric surgery (13). Patients who undergo a duodenal switch are at additional risk of developing deficiencies in fat soluble vitamins and protein (11, 14). Nutritional deficiencies are not an inevitable outcome of bariatric surgery and can be avoided with provision of the correct aftercare combined with patient compliance.

The British Obesity and Metabolic Surgery Society (BOMSS) has produced "Guidelines on perioperative and postoperative biochemical monitoring and micronutrient replacement for patients undergoing bariatric surgery" and "GP Guidance: Management of nutrition following bariatric surgery" (15-16). The Royal College of General Practitioners has produced "Ten top tips for the management of patients post bariatric surgery in primary care" (17). These have been well received and stimulated debate about the aftercare of patients. Whilst there are national and international guidelines (7-8, 12, 15, 18-20), there is no clear agreed plan for the management of these patients in the long term within the setting of the National Health Service. With the devolvement of commissioning of treatment for sever and complex obesity, including bariatric surgery, there is a need to develop safe pathways for the care of post-operative bariatric patients.

Data on obesity patients after surgery is limited as bariatric surgeons are only required to provide information to NSBR for 2 years. Subsequently, when patients are no longer under the bariatric surgeon, long term data are poorly collected.

Ongoing research studies may contribute to future practice including the follow-up of bariatric surgery patients; these include The SurgiCal Obesity Treatment (SCOTS) Study and the By-Band-Sleeve Study (21, 22). SCOTS is a 10 years longitudinal study following all patients undergoing bariatric surgery in Scotland (21). A wide range of outcomes including mortality, diabetes, complications, weight change, nutrition and quality of life will be measured. It is expected that the results will be available by 2026. The By-Band-Sleeve Study being conducted in Bristol, UK is a multi-centre randomised controlled trial designed to compare gastric band, gastric bypass and sleeve gastrectomy procedures (22). Outcomes measures will include complications, weight changes, nutrition and quality of life measures. The results of this study are expected in 2025.

This guideline is the first to outline the operational requirements and pathways for long term care of patients who undergo obesity surgery.

Scope

Aims and objectives of service

Aim

- Improve follow-up and aftercare to patients undergoing bariatric surgery
- Ensure that the best clinical outcomes are achieved
- Enable patients to have access to appropriate monitoring and aftercare
- Empowering the patient to play an active role in aftercare.

Objectives:

To ensure

- Robust follow-up and aftercare of patients including timely support from the appropriate healthcare professionals
- Long term nutritional monitoring and appropriate interventions
- Timely access to psychological support as and when needed
- Good communication between the bariatric surgery providers, GPs and Tier 3 specialist medical obesity services
- Empowering the patient by providing more awareness of their new body physiology following bariatric surgery and to take a lead in self-care with the help of professionals.
- Patient education including: importance of maintaining optimum bone and neuronal metabolism with advancing age - both affected adversely in poorly optimized patients post bariatric surgery; role of physical activity; weight maintenance.
- Information about professionally-led or peer-support groups
- GP education
- Monitoring/recall systems/collection of data for NBSR and review of that data.

Methods

NHS England Obesity Clinical Reference Group (CRG) commissioned a subgroup to develop bariatric surgery follow-up guidelines. The membership included health professionals (surgeon, dietitian, nurse and physician) experienced in obesity and bariatric surgery, general practitioners, patient representatives and a public health doctor. The group agreed terms of reference and scope. The group members took responsibility for different sections of the guidelines depending on their areas of expertise and experience with bariatric surgery patients. The quality of evidence was rated and the strength of the recommendations graded using graded ‘‘Grading of Recommendations Assessment, Development, and Evaluation’’ (GRADE) approach (23). Where guidance has been provided by NICE or NCEPOD, we have adopted their recommendations. All drafts were circulated. Feedback from the subgroup was given at a CRG meeting. There was wide consultation with the Obesity CRG members.

Service description/care pathway

The service pathway covers the following stages:

1. Immediate postoperative care
2. Follow-up by the bariatric surgical service
3. Long term follow-up

Immediate postoperative care

The majority of gastric band surgery is day case. There has been a significant reduction in the inpatient stay following gastric bypass and sleeve gastrectomy surgeries to 1-2 days. Duodenal

switch patient may stay 4-5 days. Patients should be nursed in a high dependency unit or on a surgical ward according to their post-operative needs.

A track and trigger system should be implemented to manage patients on the wards (1, 24). Monitoring of the cardiovascular and respiratory status is essential in the postoperative period. Identifying early signs and symptoms of complications, including pain, vomiting, tachycardia, tachypnoea, hypotension, chest and calf pain, and shortness of breath, acting on them and escalating care to the surgical team are vital skills of the nursing staff managing the bariatric surgical patient.

Recommendation: A track and trigger system should be implemented to manage patients on the wards outside of critical care. Evidence: NICE recommendation

Nursing staff should be trained to monitor for postoperative complications including leaks, haemorrhage, DVT/PE, sepsis, wound infections and respiratory and cardiovascular complications. Other aspects of nursing care to monitor include the management of diabetes, hypertension and obstructive sleep apnoea. Patients on CPAP should resume use post-surgery as instructed by surgeon. This should be clearly documented.

Most UK bariatric surgical dietitians educate their patients preoperatively with respect to postoperative diet requirements so that patients are fully versed with what they can, and cannot, eat at the time of discharge. This should be supported by clearly written postoperative dietary guidelines tailored to the patient's needs (2-3, 7-8, 12). Educating the patient pre-operatively negates the need for the patient to see the dietitian prior to discharge.

Recommendation: Patients should receive a consultation with a specialist dietitian regarding diet and food progression. Evidence: GRADE B

A pharmacist with experience in bariatric surgery should review medications and can advise on converting the patient's usual medication into a form that can easily be tolerated, and remains safe and effective post-surgery, e.g. liquid equivalents, medications that can be crushed and capsules that can be opened with the avoidance of effervescent and sugary preparations. (Many bariatric surgical services recommend that all medication should be in a soluble, crushable or liquid form for a period of 4 to 6 weeks)(25).

Recommendation: A pharmacist with experience in bariatric surgery should review medications prior to surgery and advise on converting the patient's usual medication into a form that can easily be tolerated post-surgery and remains clinically effective Evidence: GRADE D

Bariatric surgery is usually performed laparoscopically so avoiding large painful laparotomy wounds. Analgesia should follow the usual pain relief ladder with a combination of analgesics working via different pain pathways. Some more complex patients are already on opiates prior to surgery and they need special consideration and counselling preoperatively so they have realistic pain control expectations.

Patients should be assessed after surgery for the long term continuation of medication for diabetes and hypertension. These medications may require complete cessation or dose modifications in the immediate postoperative period (with regular monitoring of blood pressure (BP) and capillary or venous glucose) to prevent postural hypotension and hypoglycaemia respectively (26). All other medications need to be taken with dose modifications if required. However, it should be made clear to patients and all caring teams that type 2 diabetes relapses in a proportion of patients with time and, moreover, the effect of weight loss on hypertension is variable, incomplete and often temporary (27).

Patients with diabetes need clear guidance with respect to the reduction and/or cessation of their hypoglycaemic medication(s) over time. The patient should be reviewed by a diabetes specialist nurse, diabetes or bariatric physician prior to discharge. Patients should be empowered to check their blood glucose level regularly and adjust their medication appropriately. Instructions on changes made prior to discharge, and the ongoing need to regularly monitor and modify medication should be clearly documented in the discharge summary and communicated to the GP.

Anti-hypertensive medication should be reviewed, and may need adjusting, including reviewing the formulation.

Recommendation: Antihypertensive and diabetes related medications may be stopped or dose modified in the immediate postoperative period (with regular monitoring of BP and blood glucose). Other medications may need dose modification.

Patients with diabetes need clear guidance with respect to the reduction and/or cessation of their diabetic medication including the advised time period and review by a diabetic specialist nurse, diabetes or bariatric physician.

Evidence: GRADE D

There is no UK wide consensus with respect to the best venous thromboembolism (VTE) prophylaxis regimen (28), but many units will teach patients to self-administer subcutaneous heparin (or equivalent) for 7-14 days post-surgery. Patients are supplied with prepared syringes and a sharps box.

All patients should be supplied with graduated compression stockings (unless contraindicated) and intermittent pneumatic compression (IPC) devices. Early mobilisation, breathing exercises and coughing, and involvement of the bariatric physiotherapists to review patients on the ward post-surgery is encouraged. The wearing of anti-thrombotic stockings is encouraged, but it is recognised that many patient cannot get appropriately sized stockings to fit or they are worn incorrectly (28).

Recommendation: VTE prophylaxis for 7-14 days post-surgery.

All patients should be supplied with graduated compression stockings (unless contraindicated) and intermittent pneumatic compression (IPC) devices.

Evidence: NICE recommendation

Patients with known obstructive sleep apnoea (OSA) should bring their CPAP or BIPAP devices in with them for surgery and continue to use it for 3 - 6 months post-surgery. There is robust evidence that CPAP pressure requirement is markedly reduced or there is complete resolution of OSA following bariatric surgery induced weight loss (29-30). However there is no clear evidence when it is safe to return their devices to their local respiratory team; therefore patients should be reviewed by the respiratory physician who will determine whether the BIPAP /CPAP pressures need to be adjusted and when a further sleep-respiratory assessment should be undertaken.

Recommendation: Patients with known obstructive sleep apnoea should be asked to bring their CPAP or BIPAP device in with them for surgery and recommended to continue using them for 3 - 6 months post-surgery. Patients should be reviewed by the respiratory physician as the BIPAP /CPAP pressures may need to be adjusted and a further sleep-respiratory assessment undertaken.
Evidence: GRADE D

Wounds should be assessed and redressed on the ward. Skin staples, if used, can be removed at 10-14 days by the practice nurse; most surgeons use subcuticular self-dissolving sutures or skin glue. A letter of instruction is to be given to the patient on discharge for the practice nurse and clearly documented in the discharge summary.

Patients are advised not to get pregnant within eighteen months following bariatric surgery due to potential adverse consequences both to the mother and the foetus (26, 30).Those who are of child bearing age and sexually active are encouraged to use appropriate non-oral contraception (implant, intra-uterine or barrier). The approaches are believed to be the best because of the potential for vomiting or diarrhoea after surgery and impaired absorption of oral contraception in malabsorptive and restrictive procedures (7-8, 32).

Recommendation: Women are advised not to get pregnant within eighteen months following bariatric surgery. Appropriate non oral contraception should be considered (implant, coil or barrier are believed to be the best because of vomiting or diarrhoea and impaired absorption).

Evidence: GRADE C

Patients should be given the contact details of the dietitian, bariatric specialist nurse and an emergency contact number on discharge.

To facilitate seamless care, a printed discharge summary, including the postoperative discharge plan, must be provided to the GP within 24 hours (2). This should state all medications including vitamins

and mineral supplements, changes in mode of delivery and potential surgical and medical complications in the immediate postoperative period.

The bariatric surgery team should arrange a follow-up telephone call with the patient within seven days of surgery (2).

Recommendation: A comprehensive written discharge summary including the postoperative discharge plan needs to be provided to the GP within 24 hours.

The bariatric surgery team should arrange a follow-up telephone call with the patient within seven days of surgery.

Evidence: NCEPOD recommendation

Bariatric surgery centre follow-up (first two years)

All bariatric surgery teams should follow-up patients by telephone and in person at regular intervals post-surgery and offer a minimum of two year follow-up (3, 7-8, 15-16). Access should be available to the appropriate healthcare professionals including surgeon, dietitian and nurse. The team should assess whether input from a bariatric physician and clinical psychologist/psychiatrist is required and access provided if needed.

Patients should be well supported to meet the demands and issues that follow bariatric surgery. This includes managing the metabolic changes and dietary changes. The frequency of follow-up will be determined by the patient's needs, the bariatric procedure and severity of other comorbidities (7-8, 15, 20, 33-34).

Recommendation: All multidisciplinary bariatric surgery teams should follow-up patients at regular intervals post-surgery and offer a minimum of two year follow-up.

Access should be available to appropriate healthcare professionals including surgeon, dietitian, nurse, clinical psychologist/psychiatrist and bariatric physician.

Evidence: NCEPOD recommendation

Appropriate tests (biochemical, haematological and nutritional) should be taken following the primary bariatric procedure. Full details of the blood tests, including suggested timing and frequency, are in the BOMSS guidance but if any unexpected symptoms or problems occur, blood tests should be taken sooner (7-8, 15). If a patient has been vomiting excessively additional thiamine supplementation is recommended (35). At each patient encounter the NBSR database should be updated (1).

Recommendation: Routine monitoring of biochemical, haematological and metabolic changes is recommended following bariatric surgery (BOMSS guidance)

Evidence: GRADE A

Surgical Follow-Up

The majority of postoperative bariatric surgery patients do not need to be seen by a surgeon at each appointment, but by appropriately trained allied healthcare professionals who have easy access to a surgeon if required. The patient's weight should be recorded. An enquiry into the resolution of weight related co-morbidities should be made and changes to medication and doses recorded. Checks should be made to ensure that patients are on the appropriate multivitamins and minerals for the surgery performed (15). Where there is any suspicion of post-operative complications such as a stricture or symptomatic hernia, the patient should be seen and assessed by the surgeon.

Specialist bariatric dietitian

The dietitian supports the patient to make the dietary, behavioural and lifestyle changes required to optimise nutrition and achieve the weight loss and metabolic goals. The level of support required varies between patients and may also be influenced by the surgical procedure. The majority of patients will require telephone review and support in the first few weeks, an initial 6 week review and then may require frequent appointments or reviews (for instance 4 to 6 weekly) in the first year. These may be face to face and by telephone. The frequency of follow-up may decrease in the second year. The patient needs access to robust support with the dietary, lifestyle and psychological changes required and some may require more support than others (2, 5, 36). The dietitian will assess the nutritional status, check compliance with vitamin and mineral supplements and provide advice on any additional nutritional and behaviour changes including additional supplements required. The bariatric dietitian usually has the most frequent contact with the patient and should have ready access to a surgeon/physician/clinical psychologist if there are any concerns.

Recommendation: Bariatric specialist dietitians should support the patient and should have ready access to a bariatric surgeon/physician/clinical psychologist if there are any concerns.

Evidence: NICE and NCEPOD recommendations

Specialist bariatric nurse

The role of the bariatric nurse is to ensure coordinated care for the patient while in hospital. He/she liaises with supporting staff, ensures availability of appropriate equipment and trained staff to deliver safe and effective care to bariatric patients. The nurse provides specialist nursing care, support and advice to bariatric inpatient and outpatient care from assessment and throughout the pathway. He/she works as part of the multidisciplinary team to ensure patients are optimised for surgery. He/she also has a role in supporting patients' information needs through educational group sessions and one to one discussions if required. Patients should be reviewed on the wards post-surgery, telephoned within the first week of discharge to offer support and address any concerns, and then reviewed 2-3 weeks post-surgery. Medication, diet, wound care, physical activities, management of diabetes, hypertension and the use of CPAP should be discussed. The specialist bariatric nurse should give support to the nursing staff caring for bariatric patients to ensure policies

and protocols are adhered to and a high quality of evidence based care is delivered. Telephone contact is provided to patients in case of emergency.

The specialist bariatric nurse may be trained in band adjustments and management (see gastric band surgery).

Recommendation: Specialist bariatric nurse should be involved providing specialist nursing care, support and advice to bariatric inpatient and outpatient care from assessment and throughout the pathway. Evidence: GRADE D

Access to clinical psychologists/psychiatrists/physician

An assessment for the requirement of a bariatric physician and psychology/psychiatric input must be made and appropriate support provided should the patient require it (2, 37). Since many patients have multiple co-morbidities, ongoing review is still needed by the appropriate medical teams. Medication requirements may change.

Where patients are receiving care for other medical or surgical conditions (e.g. cardiovascular disease, renal failure, epilepsy) communication with their specialist and general practitioner to keep them informed of progress is essential.

Some patients may need additional support psychologically. Patients may struggle to adapt to the demands and pressures resulting from bariatric surgery. Access to additional counselling may be required.

Recommendation: An assessment for the requirement of bariatric physician and clinical psychology/psychiatric input must be made and provided should the patient require it. Evidence: NCEPOD recommendation

Gastric band surgery

Depending on the make of gastric band that has been placed, the first band fill is usually undertaken between 4-6 weeks. Subsequent follow-up appointments should be every 4-6 weeks for the next 3-6 months with reiteration of how the band functions, portion size, diet and food texture. Patients who have regular follow-up tend to have a greater weight loss than those who do not (8, 38-39). After this period, appointments for band reviews every 3-6 months should suffice, but with patients given clear instructions to get in contact sooner if there are symptoms that a band is too tight (such as dysphagia, vomiting, heartburn and nocturnal coughing). Patients with heartburn with a band in-situ have a tight band and need their bands deflating rather than being prescribed antacids or proton pump inhibitors. In some bariatric surgical services, the specialist bariatric nurse may do the gastric band adjustments undertaking a joint clinic with a specialist bariatric dietitian.

Recommendation: Patients need frequent follow-up following the placement of the gastric band until the optimal band fill is achieved.

Gastric band patients should have annual follow-up indefinitely.

Evidence: GRADE C

Sleeve gastrectomy /gastric bypass / duodenal switch

Within the bariatric surgical service, there is usually an initial follow-up at 6-8 weeks postoperatively, every three months for the first year, then every six months in the second year as a minimum (20). Patients may have additional appointments with the dietitian which may be face to face or by telephone.

Recommendation: Within the bariatric surgical service, there should be an initial follow-up at 6-8 weeks postoperatively, every three months for the first year, then every six months in the second year as a minimum. Continuity of care with ongoing support following bariatric surgery is essential for achievement of long term weight loss and metabolic goals. High risk patients such as duodenal switch or biliopancreatic diversion patients probably require lifelong follow-up in the specialist centre.

Evidence: GRADE D

Nutritional monitoring

In addition to the dietetic assessment, patients will require lifelong nutritional monitoring to ensure that optimum nutrition is maintained. The bariatric multidisciplinary team should ensure that the appropriate monitoring takes place and that any abnormal investigational (biochemical, radiological) results or clinical issues are addressed (7-8, 15). Full details are available in the BOMSS “Guidelines on perioperative and postoperative biochemical monitoring and micronutrient replacement for patients undergoing bariatric surgery” (15).

Recommendation: Patients should have lifelong nutritional monitoring to ensure optimum nutrition is maintained.

Evidence: NICE recommendation

Diabetes mellitus

Type 2 diabetes mellitus (DM) in many patients may remit (achievement of acceptable glycaemia without medication) or control may improve following bariatric surgery. Monitoring of glycaemic status using fasting and postprandial capillary or venous glucose in the postoperative period is advised and this will require patients, even with type 2 diabetes to be able to undertake self-monitoring and have access to glucose meters and measuring strips. The patients’ GPs should be

informed of the need for self-monitoring and prescription of measuring strips post-operatively. Patients should be discharged only from close perioperative follow-up after glycaemic status is well-controlled on the advised dietary regimen with review at times of diet transition. HbA1c should not be used until the patient has stabilised after surgery.

Remission of diabetes will be achieved in a large number of patients following bariatric surgery (40-41). However, any triggers such as weight regain, pregnancy, severe infection or trauma should prompt the caring team to reassess glycaemic status and treat appropriately. Patients should remain on the practice diabetes register, and continue to be reviewed for micro and macrovascular complications of diabetes on an annual basis. There should be close communication between the bariatric and diabetes teams.

Patients with Type 1 DM might also need to reduce doses of insulin due to improved insulin sensitivity and hence require regular follow-up based on individual patient need.

Recommendation: Patients should be discharged only if acceptable glycaemic control on the advised dietary and pharmaceutical regimen with review at times of diet transition. Metformin should continue also contraindicated.

Patients with diabetes mellitus should continue to be reviewed annually for micro and macrovascular complications of diabetes.

Patients with Type 1 DM may need to reduce doses of insulin due to improved insulin sensitivity.

Evidence: GRADE D

Dumping syndrome and Post Prandial Hypoglycaemia (PPH)

These occur after gastric bypass, but less commonly after duodenal switch and sleeve gastrectomy.

Dumping syndrome refers to predominantly GI symptoms that occur early (10-30 minutes) after a meal often precipitated by 'inappropriate' foods. Patients should be advised on how to manage dumping syndrome and to adhere to the prescribed bariatric diet.

PPH refers to hypoglycaemia with its associated symptoms that is often provoked by high glycaemic index foods or drinks resulting in hypoglycaemia typically 45-90 minutes after ingestion. This can be severe and even lead to loss of consciousness. Both the patient and primary care physician should be educated about postprandial hypoglycaemia

Nutritional intervention is the mainstay of dumping and PPH syndrome (small, frequent, low carbohydrate meals) (8). However, for hyperinsulinaemic hypoglycaemia, an urgent referral might be required to an endocrinologist for detailed investigations such as CT scan or selective arterial calcium stimulation test to exclude other causes and to consider pharmacological management if dietary advice is insufficient to control the problem.

Recommendation: Both the patient and primary care physician should be educated about postprandial hypoglycaemia after gastric bypass due to pancreatic beta cell hypertrophy which can occur several months to years after surgery.

Small frequent low glycaemic index meals are advised to treat both dumping and PPH syndromes.

Further investigation and management of hypoglycaemia is needed if the patient fails to respond to dietary manipulation.

Evidence: GRADE D

Lipids

Patients with dyslipidaemia and on lipid-modifying medications should be reassessed with fasting lipid profiles periodically. The liver shrinkage diet which is recommended up to four weeks prior to the bariatric surgery usually improves hypertriglyceridaemia. Insulin sensitivity following bariatric surgery also aids in improving lipid profile particularly HDL cholesterol and triglycerides (42). Patients with familial hyperlipidaemias will need to remain on lipid lowering medications and under review of a lipid specialist to manage cardiovascular risk. Patients with high cardiovascular risk (i.e. QRISK2 >10%) prior to surgery are likely to remain at high risk and should have their medication reviewed (43).

Emphasis should be made for bariatric surgery patients with high cardiovascular risk regarding prevention of vitamin B12 deficiency by regular parenteral vitamin B12 injections (high risk patients include patients on proton pump inhibitors or metformin, as well as vegetarians) as vitamin B12 deficiency is associated with variety of atherogenic processes (44).

Recommendation: Patients with dyslipidaemia and on lipid modifying medications should be reassessed with fasting lipid profiles periodically including reassessment of cardiovascular risk status.

Patients with familial hyperlipidaemias will need to remain on lipid lowering medications and under review of a lipid specialist to manage cardiovascular risk.

Emphasis should be made for bariatric surgery patients with high cardiovascular risk regarding prevention of vitamin B12 deficiency by regular parenteral vitamin B12 injections.

Evidence: GRADE D

Bone health

Obese subjects have low vitamin D before surgery which is likely to be due to a combination of poor diet, poor absorption and a lack of skin exposure to natural sunlight. A systematic review shows that patients do not have their hypovitaminosis D corrected prior to surgery (45). Moreover, bone mineral density falls after obesity surgery (46).

A randomised study of patients given loading doses of vitamin D before and maintenance doses after surgery showed that active treatment resulted in less bone loss (47). The current data do not offer adequate information to guide dosing (45) leading to conflicting advice in osteoporosis guidance (48). It should be noted that changes in vitamin D therapy require a minimum of three months before serum vitamin D concentrations stabilise (49).

A good oral intake of calcium is important. Following a gastric bypass, sleeve gastrectomy and duodenal switch BOMSS guidelines recommend additional calcium supplementation (15). This is usually a minimum of 800 to 1200 mg calcium for a sleeve gastrectomy and gastric bypass (15). More may be required following a duodenal switch.

Patients who have had a gastric bypass, duodenal switch or biliopancreatic diversion may require dual-energy x-ray absorptiometry (DEXA) to monitor for osteoporosis (8, 18).

Recommendation: All patients should have their vitamin D status assessed and treated prior to surgery and should have replacement prescribed after surgery.

Evidence: GRADE B

Medications

Pharmacotherapies should be assessed and medications discussed with a pharmacist with consideration of altered pharmacokinetics and pharmacodynamics of drugs following bariatric surgery, e.g. sustained release medications might need to be substituted with immediate release medications. Patients will need liquid preparation of necessary drugs during the early postoperative period for example thyroxine, immunosuppressants, antipsychotics, anticonvulsants etc. (26). Some drugs might need to be substituted with alternative drugs or increased doses due to impact on their absorption site depending on the bariatric surgery type, e.g. decreased efficacy of lamotrigine, enalapril, ramipril, simvastatin, phenytoin, rifampicin, digoxin (50-51). Where possible monitoring of blood levels to ensure therapeutic levels are maintained is recommended. The primary care specialist should refer such cases if it is difficult to optimize patient. Generally patients who have had a gastric bypass are discharged on prophylactic proton pump inhibitors to help reduce marginal ulcers.

Recommendation: Pharmacotherapies should be assessed and medications discussed with a pharmacist with careful consideration of altered pharmacokinetics and pharmacodynamics of drugs following bariatric surgery. Metformin should be continued unless contraindicated.

Evidence: GRADE D

There should be a review of patients at regular intervals to check metabolic status and to titrate correct doses of certain medications, e.g. thyroxine dose might need to be reduced following weight loss (53), absence of which can lead to cardiac complications in a patient with low cardiac reserve due to hypermetabolism.

Patients on anti-coagulants, e.g. warfarin, low molecular heparin, should be managed by the bariatric multidisciplinary team (MDT) in conjunction with the anti-coagulation team, especially patients with a duodenal switch who are more likely to develop fat soluble vitamin deficiencies, e.g. Vitamin K (14). Detailed dietary advice about vitamin K content of foods and warfarin interaction should be provided to patients by the bariatric dietitian and anti-coagulation team.

Recommendation: Patients on anti-coagulants, e.g. warfarin, low molecular heparin, should be managed by the bariatric MDT in conjunction with the anti-coagulation team, especially patients with a duodenal switch who are more likely to develop fat soluble vitamin deficiencies.

Evidence: GRADE D

Preconception and pregnancy

Patients should be advised to avoid pregnancy for the first eighteen months following surgery by which time the patient is likely to be weight stable and able to consume a nutritionally balanced diet (8). Women with polycystic ovary syndrome should be advised that weight loss may result in increased fertility; therefore they need to use contraception to avoid an accidental pregnancy (8). Discussions around preconception vitamin and mineral supplements should take place, including the need for additional folic acid and avoiding supplements containing vitamin A in the retinol form (15). Preconception advice should be available to those women who are planning pregnancies (8, 15, 54-55). During the preconception period, serum vitamin B12 should be measured along with folate before starting patients on folic acid as folic acid supplementation in a vitamin B12 deficient patient can lead to severe neurological complications (56). Robust communication with the antenatal team involving the patient should be established to allow combined care of the patient by imparting increased awareness to the antenatal team about the risk of nutritional deficiencies that the mother and foetus are exposed to due to bariatric surgery. Pregnant women require more frequent follow-up and nutritional monitoring should be increased to every trimester (15, 31, 57-58).

Recommendation: Women should have access to preconception counselling and advice regarding nutritional supplements and should be warned of the potential for increased fertility.

Robust communication with the antenatal team should be established to increase awareness to the antenatal team about the risk of nutritional deficiencies that the mother and foetus are exposed to due to bariatric surgery. Pregnant women require more frequent follow-up and nutritional monitoring should be increased to every trimester.

Evidence: GRADE D

Pre-existing mental health conditions

Patients with pre-existing mental health conditions may need review of their condition including medication reviews (50-52). Some medications may be associated with increased appetite and thirst. Patients may need additional psychological/psychiatric support and there should be good communication with the patient's psychologist /psychiatrist.

Recommendation: Patients with pre-existing mental health conditions may need medication reviews.

Evidence: GRADE C

Access to psychological support

Inevitably in the longer term, some patients will experience weight regain or return of obesity related comorbidities and may struggle psychologically with this. There are also reports of some patients presenting with addiction transfer, alcohol and substance misuse or increased risk of suicide (60-62). Psychological support should be available.

Recommendation: Some patients may struggle psychologically, experience addiction transfer, alcohol and substance misuse or have an increased risk of suicide. Psychological support should be available. Evidence: GRADE D

Advice on physical activity and exercise

As patients lose weight, they may need support and encouragement to become more physically active (8). Some will benefit from referral to specialist physiotherapy or specialist exercise programmes.

Recommendation: As patients lose weight, they may need support and encouragement to become more physically active. Some will benefit from referral to specialist physiotherapy or specialist exercise programmes. Evidence: GRADE D

Patient groups who may require more frequent follow-up and support

Some patient groups may require more frequent follow-up because of their higher risk of metabolic and biochemical complications. These include:

- Women who become pregnant (31, 63) or who are breastfeeding (64)
- Women with menorrhagia (iron deficiency anaemia) (65)
- Patients on proton pump inhibitors and metformin* (B12 deficiency) (66)
- Patients who have had duodenal switch surgery (greater risk of protein malnutrition and fat soluble vitamins deficiency) (11, 14)
- Patient with co-existing malabsorptive conditions such as coeliac disease*, tropical sprue, inflammatory bowel disease
- Patients with renal impairment* or single kidney, kidney stones (67)
- Transplant patients*
- Patients who are immobile or who are wheelchair users

- Patients on thyroxine or multiple myeloma* patients (high bone turnover likely)
- Patients with high cardiovascular risk* (should not be given high calcium doses)
- Patients with previous history of binge eating disorder
- Patients with psychiatric conditions*

* Many of these patients will be under the care of other medical professions and it is important to maintain good communication with other healthcare professionals kept informed.

Recommendation: Some patient groups may require more frequent follow-up because of their higher risk of metabolic and biochemical complications (see above). Many of these patients will be under the care of other medical professions and it is important to maintain good communication with other healthcare professionals kept informed. Evidence: GRADE C

Patients who do not attend follow-up

Unfortunately, a small number of patients may not attend their follow-up appointments. This is of concern as these patients may be vulnerable to long term clinical and nutritional problems. Bariatric surgical services should set up a system to minimise the risk that patents are lost to follow-up. If a patient persistently does not attend for follow-up, the bariatric centre should contact the GP and put their concerns in writing to both the GP and patient. The GP and, importantly, the patient must be informed of the need for continued nutritional monitoring and compliance with vitamin and mineral supplements.

Recommendation: Bariatric surgical services should set up a system to minimise the risk that patents are lost to follow-up. If a patient persistently does not attend for follow-up, the bariatric surgical services should contact the GP and put their concerns in writing to both the GP and patient. The GP and, importantly, the patient must be informed of the need for continued nutritional monitoring and compliance with vitamin and mineral supplements. Evidence: GRADE D

Access to patient support groups

Many patients benefit from peer support (8). Patients should have been advised prior to surgery of local patient support groups and online forums and websites such as http://www.wlsinfo.org.uk/ and http://www.bospauk.org/

Recommendation: Patients should have been advised prior to surgery of local patient support groups, online forums and websites. Evidence: GRADE D

When should the primary care physician refer back in early stages?

The assessment of the obese patient is difficult following recent bariatric surgery and primary care physicians should have a low index of suspicion that something is not right and refer in a timely and appropriate manor (See BOMSS poster available at http://www.bomss.org.uk/wp-content/uploads/2014/04/ED_Poster_Complications_Version_6.pdf) (68).

Serious problems within the first two weeks include:

- Acute renal failure
- Abdominal pain, tachycardia and pyrexia. This may indicate a leak or iatrogenic bowel injury until proved otherwise and requires emergency admission
- Chest pain, shortness of breath and tachypnoea. This may indicate a pulmonary embolus until proved otherwise and requires emergency admission
- Unilateral or bilateral swollen legs. This may indicate a DVT
- Continuous vomiting, with or without abdominal pain. This may indicate an over tight or slipped gastric band, stenotic anastomosis, kinked gastric sleeve or a bowel obstruction until proved otherwise and requires emergency admission
- Following the insertion of a gastric band a wound infection associated with the port site should be taken seriously. Some surgeons are happy to remove the infected port, tie off the tubing and wait for all signs of infection to pass before replacing the port. Other surgeons believe that the whole prosthesis is infected and will remove it all.

Less serious problems within the first two weeks include:

- Dehydration with resulting constipation which is common post bariatric surgery. Little and often is encouraged with respect to fluid intake to achieve an intake of 2 litres a day
- Patients with a gastric balloon will feel awful for a week with nausea and vomiting. Most settle, but occasionally may need to be admitted for intravenous fluids
- Bruising/haematomas at the port sites.

Discharge from bariatric surgical service after 2 years

In England, patients must be followed-up in the bariatric surgical service for a minimum of two years. Patients must receive long term follow-up (3) and there are a number of suggested shared care models included in the appendices of this article. Clinical problems such as chronic diarrhoea or severe reactive hypoglycaemia should be addressed before the patient's care is transferred. The patient may need continued support from the bariatric dietitian if they are still struggling with the nutritional balance of the diet or continued weight loss. It may be appropriate for duodenal switch patients to receive lifelong follow-up from the bariatric surgical service. Once discharged from the bariatric surgical service, patients should all have a yearly follow-up by appropriately trained health

professionals who will check the patient's weight, multivitamin and mineral supplementation, annual blood tests and enquire about the resolution of weight related co-morbidities. Ideally this information should be relayed back to the bariatric surgical service to add onto the NBSR. At any stage, if there are clinical concerns or help is required to interpret investigation the bariatric surgical service should be contacted.

Recommendation: Following discharge from the bariatric surgical service, all patients should have a yearly follow-up by appropriately trained health professionals (see later for details of recommended annual review). Evidence: GRADE D

At discharge, the focus is on weight maintenance rather than continued weight loss. Before discharge the patient should be supported to develop skills which will help with weight maintenance. Continued food monitoring, regular weight checks, balanced diet and increased activity are all key components of weight management strategies.

Final discharge letters to primary care at two years

The discharge letters must contain full details of the following: bariatric procedure, emergency contact numbers, annual blood tests required, long term vitamins and minerals supplements, life style modifications and a list of symptoms which may indicate late surgical complications that would warrant referral back to the bariatric surgical service (appendix 1). Letters should be sent to the GP and the patient.

Recommendation: Discharge letters must contain full details of the following: bariatric procedure, emergency contact numbers, annual blood tests required, long term vitamins and minerals supplements, life style modifications and when to refer back. Letters should be sent to the GP and the patient. Evidence: Grade D

Long term follow-up

NICE CG189 (obesity) recommends that after discharge from bariatric surgical service follow-up that all patients are offered at least annual monitoring of nutritional status and appropriate supplementation according to need following bariatric surgery, as part of a shared care model of chronic disease management (3).

Long term monitoring

Monitoring should include the following:

- Assessment of nutritional intake (7-8, 12)
- Nutritional monitoring (3, 7-8, 12, 15)
- Weight check
- Assessment of co-morbidities
- Review of multivitamin and mineral supplements (check compliance)
- Investigation of abnormal results and appropriate treatment as required (7-8, 15)
- Review of potential concerning symptoms such as vomiting and heartburn.

Recommendation: Annual review should include an assessment of nutritional intake, nutritional monitoring, weight check, assessment of co-morbidities, review of multivitamin and mineral supplements and investigation of abnormal results and appropriate treatment as required.

Evidence: GRADE C

Some patients may have excess skin because of the weight loss resulting in physical discomfort, decreased mobility and psychosocial problems (33, 69). Consideration for plastic /reconstruction surgery should be given.

Recommendation: Information on, or access to, plastic surgery (such as apronectomy) should be given when appropriate.

Evidence: NICE recommendation

Many patients will experience some weight regain and this is perfectly normal. However, it is extremely disheartening and may cause anxiety. Patients should be encouraged to maintain lifestyle changes, monitor food intake, have regular weight checks and be active. Some patients may benefit from a review with the specialist bariatric dietitian, or enrolment and attendance at a community based weight management groups. Where there is excessive weight gain, consideration should be given to referring the patient back to Tier 3 for assessment if there are no accompanying surgical red flags.

Recommendation: Patients should be encouraged to maintain lifestyle changes, monitor food intake, have regular weight checks and be physically active. Where there is excessive weight gain, consideration should be given to referring the patient back to Tier 3 for assessment if there are no accompanying surgical red flags.

Evidence: GRADE D

Overview of shared care protocols for the management of post bariatric surgery patients

Whilst the concept of shared care is new to bariatric surgical service, the principle is established in other areas for example monitoring rheumatology second line medications. The choice of model will be dependent on local commissioning choices, resources and available skill sets. They may include variations for different surgical options. For instance gastric band refills may be done in secondary

care settings, and people with very complex operations such as biliopancreatic diversion (BPD) or duodenal switch may need permanent follow-up within an expert bariatric surgical service or specialist obesity Tier 3 service.

In all the models presented in this article, the specialist centres could be co-located at the original bariatric surgical unit, a local hospital based Tier 3 service, or a community based Tier 3 service, depending on the local commissioners and availability of services.

The bariatric surgical services are required to submit long term follow-up data to the National Bariatric Surgery Register (NBSR) (1-2). This will include the NHS number from late 2015. It is important that whoever sees the patient at follow-up appointments completes the appropriate form and returns it to the original surgical unit for submission to the NBSR database.

This document refers to NHS operations, but private surgical providers should be responsible for organising appropriate follow-up and sending the patient's GP the appropriate guidance.

Recommendation: After discharge from the bariatric surgical service, follow-up all patients should be offered at least annual review, including monitoring of nutritional status and appropriate supplementation according to need, as part of a shared care model of chronic disease management.

Evidence: GRADE D

Possible models of care

Model 1: GP annual blood tests and co-morbidities review model

In this model, the patient's care is shared between the specialist centre and the GP. This ensures that the patient has access to specialist advice and support. Capacity would need to be built into the specialist centres to accommodate annual reviews. Both the GP and the specialist centres need robust systems to ensure annual reviews take place.

Model 2: GP annual blood tests and co-morbidities review plus model

In this model, the patient is followed up by GP only, with an annual nutritional review provided by the Tier 3 dietitian (and referral back if necessary). This nutritional review may be via a face to face, telephone, postal or electronic consultation. The GP needs a robust system to ensure the review takes place and timely information is sent to the specialist centre. The GP would also be charged with the responsibility of forwarding appropriate data back to the original surgical unit for entry to the NBSR.

Model 3: Specialist follow-up model

In this model, the patient is followed up by specialist team (usually a local Tier 3 service). There needs to be a robust recall system and the service must be commissioned and funded to enable annual review. There needs to be good communication with the GP. If the patient moves out of area, the care may need to be passed onto another specialist team. The specialist centre sends data to the original surgical unit for entry onto the NBSR.

Model 4: Joint appointments in primary care model

In this model, the patient is followed up jointly by specialist team and GP in the community. This ensures that the patient has access to specialist advice and support. Capacity would need to be built into the specialist centres staffing to accommodate annual reviews. Both the GP and the specialist centres need robust systems to ensure annual reviews take place. This enables knowledge and skills to be shared and may be more convenient for the patient. The specialist centre sends data to the original surgical unit for entry into the NBSR.

Full details of each shared care model are available in Appendix 2.

When should GPs refer back in later stages?

Most patients will be getting on with their lives with no issues associated with their bariatric surgery. However, problems can arise later and may require further investigation and referral back to the bariatric surgical service. These are detailed in Appendix 1.

Recommendation: Primary care physicians should be aware of potential long term problems (37) following bariatric surgery (Appendix 1) and refer back to the bariatric surgical service appropriately. Evidence: GRADE D

3. Recommendations for future development of service

All patients should receive comprehensive and lifelong follow-up and monitoring after bariatric surgery to support them in achieving an improvement in co-morbidities and prevent any long term bariatric surgery related problems (7-8, 12, 15-16, 18). In England, Clinical Commissioning Groups are responsible for ensuring that long term follow-up is provided for patients using one of the shared care models in Appendix 2.

Recommendation: Clinical commissioning groups should adopt one of the proposed shared care models and invest in the local infrastructure and training of health care professionals in the management of bariatric surgery patients. Evidence: GRADE D

Each of the models will require investment in local infrastructure. Training and up-skilling of GP, dietitians and other primary care staff in the management of bariatric surgery patients are needed (37).

Evidence: GRADE D

More healthcare professionals are coming into contact with patients who have had bariatric surgery. This includes staff working in emergency departments, obstetricians, midwives and dietitians. E-learning modules on the management of bariatric surgery patients need to be developed and available.

Recommendation: Health care professionals need to have an awareness of potential complications post bariatric surgery and refer back to the bariatric team in a timely and appropriate manner.

Continuing professional development education modules should be developed (26, 33).

Evidence Grade D

Recommendation: Healthcare professionals including obstetricians, midwives, dietitians and emergency department staff need training in the management of bariatric surgery patients. This could be in the form of e-learning modules.

Evidence: GRADE D

All emergency departments need to be aware of the management of bariatric patients who may present to the department. This includes managing band deflations if appropriate. A video on band deflation should be developed.

Recommendation: Emergency staff should be knowledgeable about the management of bariatric surgery patients who may present to the department including the management of gastric bands and band deflations.

Evidence: GRADE D

A medic alert bracelet or bariatric alert card could be used by patients. This would provide information to the acute team if a patient is brought to hospital in an unconscious state/unable to explain the bariatric surgery and medications he/she is on. An example of the information required is contained in Appendix 3.

Recommendation: A medic alert bracelet or a bariatric alert card providing details of the bariatric procedure and medications should be available for patients.

Evidence: GRADE D

Alternatives ways to facilitate long term follow-up and collection of data for NBSR should be explored including electronic food diaries, Skype and telephone consultations.

Recommendation: Alternative ways of collecting long term data for NBSR should be explored.

Evidence: GRADE D

4. Conclusions

For those patients with severe and complex obesity, bariatric surgery is a useful tool along with diet and lifestyle changes in aiding weight loss and improvements in co-morbidities. It is essential that patients receive long term follow-up and monitoring to achieve these goals, maintain the improvements in co-morbidities and weight and prevent long term problems which may arise following surgery. Access to bariatric surgical services and specialist teams varies across the country; therefore four different shared care models have been proposed. Clinical commissioning groups need to ensure that a shared care model is implemented to ensure that patient safety and long term follow-up are maintained. This will raise challenges with the need for investment in follow-up protocols, training and development of staff, input into NBSR and the funding required to support this. Long term follow-up of patients will improve outcomes and safety.

References

1. Welbourn R, Small P, Finlay I et al. National Bariatric Surgery Registry: Second registry report 2014. ISBN 978-0-9568154-8-4. Oxfordshire: Dendrite Clinical Systems Ltd.

2. National Confidential Enquiry into Patient Outcome and Death. Too Lean a Service? A review of the care of patients who underwent bariatric surgery. London: Dave Terrey; 2012.

3. National Institute for Health and Care Excellence (NICE) Clinical Guideline 189 Obesity: identification, assessment and management of overweight and obesity in children, young people and adults 2014 [Internet], London: National Institute for Health and Care Excellence. Available from: http://www.nice.org.uk/guidance/cg189 (accessed 23rd May 2015).

4. Elkins G, Whitfield P, Marcus J et al. Noncompliance with behavioural recommendations following bariatric surgery. *Obes Surg* 2005; **15(4**): 546-551.

5. Sarwer DB, Wadden TA, Moore RH et al. Preoperative eating behaviour, postoperative dietary adherence, and weight loss after gastric bypass surgery. *Surg Obes Relat Dis* 2008; **4(5)**:640-646

6. Sarwer DB, Dilks RJ, West-Smith L. Dietary intake and eating behaviour after bariatric surgery: threats to weight loss maintenance and strategies for success. *Surg Obes Relat Dis* 2011; **7(5)**:644-651.

7. Mechanick JI, Kushner RF, Sugerman HJ et al. American Association of Clinical Endocrinologists, The Obesity Society, and American Society for Metabolic and Bariatric Surgery. Medical guidelines for clinical practice for the perioperative nutritional, metabolic, and nonsurgical support of the bariatric surgery patient. *Endocrin Pract* 2008; **14(S1)**: 1-83.

8. Mechanick JI, Youdim A, Jones DB et al. Clinical practice guidelines for the perioperative nutritional, metabolic, and nonsurgical support of the bariatric surgery patient- 2013 update: Cosponsored by the American Association of Clinical Endocrinologist, The Obesity Society, and American Society for Metabolic and Bariatric Surgery. *Surg Obes Relat Dis* 2013; **9(2)**:159-191.

9. Aarts EO, Janssen IMC, Berends FJ. The Gastric Sleeve: Losing weight as fast as micronutrients? *Obes Surg* 2011; **21**: 207-211.

10. Damms-Machado A, Friedrich A, Kramer KM et al. Pre- and postoperative nutritional deficiencies in obese patients undergoing laparoscopic sleeve gastrectomy. *Obes Surg* 2012; **22(6)**: 881-889.

11. Homan J, Betzel B, Aarts EO et al. Vitamin and mineral deficiencies after biliopancreatic diversion and biliopancreatic diversion with duodenal switch--the rule rather than the exception. *Obes Surg* 2015; **25(9)**:1626-32

12. Aills L, Blankenship J, Buffington C et al. ASMBS Allied Health Nutritional guidelines for the surgical weight loss patient. Surg Obes Relat Dis 2008; 4(5): S73-S108.

13. Carlin AM, Rao S, Meslemani AM et al. Prevalence of vitamin D depletion amongst morbidly obese patients seeking gastric bypass surge *Surg Obes Relat Dis* 2006: **2(2)**; 98-103.

14. Slater GH, Ren CJ, Siegel N, et al. Serum fat-soluble vitamin deficiency and abnormal calcium metabolism after malabsorptive bariatric surgery. *J Gastrointest Surg* 2004; **8**: 48 –55.

15. O'Kane M, Pinkney J, Aasheim ET et al. BOMSS guidelines on peri-operative and postoperative biochemical monitoring and micronutrient replacement for patients undergoing bariatric surgery adults 2014 [Internet], London: BOMSS. Available from: http://www.bomss.org.uk/wp-content/uploads/2014/09/BOMSS-guidelines-Final-version1Oct14.pdf (accessed 8th Feb 2016).

16. O'Kane M, Pinkney J, Aasheim ET et al. BOMSS GP Guidance: Management of nutrition following bariatric surgery 2014 [Internet], London: BOMSS. Available from: http://www.bomss.org.uk/wp-content/uploads/2014/09/GP_Guidance-Final-version-1Oct141.pdf (accessed 8 Feb 2016).

17. Parretti HM, Hughes CA, O'Kane M et al. Royal College of General Practitioners Top ten tips for post-bariatric surgery patients in primary care. London: RCGP. Available from: http://www.rcgp.org.uk/clinical-and-research/clinical-resources/nutrition/~/media/Files/CIRC/Nutrition/Obesity/RCGP-Top-ten-tips-for-post-bariatric-surgery-patients-in-primary-care-Nov-2014.ashx (accessed 8 Feb 2016).

18. Heber D, Greenway FI, Kaplan LM et al. Endocrine and nutritional management of the post-bariatric surgery patient: an Endocrine Society clinical practice guideline. *J Clin Endocrinol Metab* 2010; **95(11)**: 4823-4843.

19. Klarenbach S, Padwal R, Wiebe N et al. Bariatric surgery for severe obesity: systematic review and economic evaluation, technology report; no. 129 2010 [Internet], Ottawa, Canadian Agency for Drugs and Technologies in Health. 2010. Available from: https://www.cadth.ca/media/pdf/H0485_Bariatric_Surgery_for_Severe_Obesity_tr_e.pdf (accessed 8 Feb 2016).

20. Fried M, Yumuk V, Oppert JM et al. on behalf of International Federation for the Surgery of Obesity and Metabolic Disorders—European Chapter (IFSO-EC) and European Association for the Study of Obesity (EASO). Interdisciplinary European guidelines on metabolic and bariatric surgery. *Obes Surg* 2014; **24**:42–55

21. Logue J, Stewart S, Munro J et al. SurgiCal Obesity Treatment Study (SCOTS): protocol for a national prospective cohort study of patients undergoing bariatric surgery in Scotland BMJ Open 2015;5:e008106. doi:10.1136/bmjopen-2015-008106 Available from: http://eprints.gla.ac.uk/107113/ (accessed 25 October 2015).

22. Rogers CA, Welbourn R, Byrne J et al. The By-Band study: gastric bypass or adjustable gastric band surgery to treat morbid obesity: study protocol for a multi-centre randomised controlled trial with an internal pilot phase. Trials 2014, 15:53 Available from: http://www.trialsjournal.com/content/15/1/53 (accessed 8 Feb 2016).

23. Guyatt GH, Oxman AD, Kunz R et al. Going from evidence to recommendations. Br Med J 2008; 336: 1049. Available from: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2376019/pdf/bmj-336-7652-analysis-01049.pdf (accessed 8 Feb 2016).

24. National Institute for Health and Care Excellence (NICE) Clinical Guideline 50: Acute illness in adults in hospital: recognising and responding to deterioration 2007 Internet], London: National Institute for Health and Care Excellence. Available from: https://www.nice.org.uk/guidance/cg50/resources/acute-illness-in-adults-in-hospital-recognising-and-responding-to-deterioration-975500772037 (accessed 8 Feb 2016).

25. Seymour K, Diaz LC, S Woodcock S. Bariatric surgery-prescribing issues. Pharm J 2008 [Internet] Available from: http://www.pharmaceutical-journal.com/learning/learning-article/bariatric-surgery-prescribing-issues/10038700.article (accessed 8 Feb 2016).

26. Sarker A, Meek CL, Park A. Biochemical consequences of bariatric surgery for extreme clinical obesity. *Ann Clin Biochem* 2016; **53**: 21-31

27. Benaiges D, Sagué M, Flores-Le Roux JA et al. Predictors of hypertension remission and recurrence after bariatric surgery. *Am J Hypertens* 2015; Sep 7. [Epub ahead of print]

28. National Institute for Health and Care Excellence (NICE) Clinical Guideline 92 2010 [Internet], London: National Institute for Health and Care Excellence. Available Venous thromboembolism: reducing the risk for patients in hospital Available from: https://www.nice.org.uk/guidance/cg92 (accessed 8 Feb 2016).

29. Lankford DA, Proctor CD, Richard R. Continuous positive airway pressure (CPAP) changes in bariatric surgery patients undergoing rapid weight loss. *Obes Surg* 2005 **15(3)**: 336-41.

30. Buchwald H, Avidor Y, Braunwald E et al. Bariatric surgery: a systematic review and meta-analysis. *JAMA* 2004; 292: 1724–1737

31. Johansson K, Cnattingius S, Näslund I et al. Outcomes of pregnancy after bariatric surgery. *N Engl J Med* 2015; **372**: 814-24.

32. Yska JP, van der Linde S, Tapper VV et al. Influence of bariatric surgery on use and pharmacokinetics of some major drug classes. *Obes Surg* 2013; **23(6)**: 819-25

33. Abela C, Stevens T, Reddy M, Set al. A multidisciplinary approach to post-bariatric plastic surgery. *Int J Surg* 2011; **9**:29-35

34. Fujioka K. Follow up of nutritional and metabolic problems after bariatric surgery. *Diabetes Care* 2005; **28**: 481-484

35. Aasheim ET. Wernicke encephalopathy after bariatric surgery. *Ann Surg* 2008; **248**: 714-720

36. Sarwer DB, Moore RH, Spitzer JC et al. A pilot study investigating the efficacy of postoperative dietary counselling to improve outcomes after bariatric surgery. *Surg Obes Relat Dis* 2012; **8**: 561-568

37. Grant P, Milan P, McGowan B et al. The bariatric physician. Clan Med 2014; **14(1)**: 30-33

38. Dixon JB, Laurie CP, Anderson ML et al. Motivation, readiness to change, and weight loss following adjustable gastric band surgery. *Obesity* 2009; **17**: 698–705.

39. Weichman K, Ren C, Kurian M et al. The effectiveness of adjustable gastric banding: a retrospective 6-year U.S. follow-up study. *Surg Endosc* 2011; **25**: 397–403

40. Dhatariya K, Flanagan D, Hilton L et al. Management of adults with diabetes undergoing surgery and elective procedures: improving standards.). 2011 [Internet]. Available from: https://www.diabetes.org.uk/About_us/What-we-say/Specialist-care-for-children-and-adults-and-complications/Management-of-adults-with-diabetes-undergoing-surgery-and-elective-procedures-improving-standards/ (accessed 8 Feb 2016)

41. Chikunguwo SM, Wolfe LG, Dodson P et al. Analysis of factors associated with durable remission of diabetes after Roux-en-Y gastric bypass. S*urg Obes Relat Dis* 2010; **6(3)**: 254-9.

42. Sjostrom L, Lindroos AK, Peltonen M et al. Swedish Obese Subjects Study Scientific Group. Lifestyle, diabetes, and cardiovascular risk factors 10 years after bariatric surgery*. N Engl J Med* 2004; **351**: 2683–2693.

43. National Institute for Health and Care Excellence (NICE) Clinical Guideline 181 Cardiovascular disease: risk assessment and reduction, including lipid modification 2014 [Internet], London: National Institute for Health and Care Excellence. Available from: https://www.nice.org.uk/guidance/cg181/resources/cardiovascular-disease-risk-assessment-and-reduction-including-lipid-modification-35109807660997 (accessed 8 Feb 2016).

44. Pawlak R. Is vitamin B12 deficiency a risk factor for cardiovascular disease in vegetarians? *Am J Prev Med* 2015; **48(6)**: 11-26.

45. Chakhtoura MT, Nakhoul NN, Shawwa K et al. Hypovitaminosis D in bariatric surgery: A systematic review of observational studies. *Metabolism* 2015 EPub Dec 19.

46. Ko BJ, Myung SK, Cho KH et al. Relationship Between Bariatric Surgery and Bone Mineral Density: a Meta-analysis. *Obes Surg* 2015 EPub Oct 13.

47. Muschitz C, Kocijan R, Haschka J et al. The Impact of Vitamin D, Calcium, Protein Supplementation, and Physical Exercise on Bone Metabolism After Bariatric Surgery: The BABS Study. *J Bone Miner Res* 2015 EPub Sep 9. 48. Chakhtoura MT, Nakhoul N, Akl EA et al. Guidelines on vitamin D replacement in bariatric surgery: Identification and systematic appraisal. *Metabolism* 2016 EPub Jan 4.

49. Heaney RP, Davies KM, Chen TC et al. Human serum 25-hydroxycholecalciferol response to extended oral dosing with cholecalciferol. *Am J Clin Nutr* 2003; **77(1)**:204-10.

50. Padwal R, Brocks D, Sharma AM. A systematic review of drug absorption following bariatric surgery and its theoretical implications. *Obes Rev* 2010; **11**: 41-50.

51. Miller AD, Kelly SM. Medication and nutrient administration consideration after bariatric surgery. *Am J Health Syst Pharm* 2006; **63(19)**: 1852-1857.

52. Sawaya RA, Jaffe J, Friedenberg et al. Vitamin, mineral and drug absorption following bariatric surgery. *Curr Drug Metab* 2012; **13**: 1345–1355.

53. Aggarwal SA, Modi S, Jose T. Laparoscopic sleeve gastrectomy leads to reduction in thyroxine requirement in morbidly obese patients with hypothyroidism. *World J Surg* 2014; **38**: 2628–2631.

54. Scientific Advisory Committee on Nutrition. Folate and disease prevention. Food Standards Agency and the Department of Health. The Stationery Office. London 2016 [Internet]Available from: http://www.sacn.gov.uk/pdfs/folate_and_disease_prevention_report.pdf (accessed 8 Feb 2016).

55. National Institute for Health and Care Excellence (NICE) Pubic Health Guidance 11 Maternal and child nutrition 2008 [Internet], London: National Institute for Health and Care Excellence.. Available from http://www.nice.org.uk/nicemedia/live/11943/40097/40097.pdf (Accessed 8 Feb 2016

56. Food Standards Agency (2003) Safer Upper Limits for Vitamins and Minerals. Expert Group on Vitamins and Minerals. 1st ed. London, Foods Standards Agency.

57. Modder J, Fitzsimons KJ. CMACE/RCOG Joint guideline management of women with obesity in pregnancy. 2010 [Internet], London Available from: https://www.rcog.org.uk/globalassets/documents/guidelines/cmacercogjointguidelinemanagementwomenobesitypregnancya.pdf (accessed 8 Feb 2016).

58. Stormdal BH, Hulthen V IA, Kublickas M et al. Causes of stillbirth at different gestational ages in singleton pregnancies. *Acta Obstet Gynecol Scand* 2014; **93**: 86-92.

59. Scholtz S, Balen AH, le Roux CW. Royal College of Obstetricians and Gynaecologists Scientific Impact Paper No. 17. The role of bariatric surgery in improving reproductive health 2015. [Internet], London: Royal College of Obstetricians and Gynaecologists. Available from: https://www.rcog.org.uk/globalassets/documents/guidelines/scientific-impact-papers/sip_17.pdf (accessed 8 Feb 2016).

60. Stevens T, Spavin S, Scholtz S et al. Your patient and weight-loss surgery. *Adv Psychiatr Treat* 2012; **18**: 418-425.

61. Conason A, Teixeira J, Hsu C-H et al. Substance Use Following Bariatric Weight Loss Surgery. *JAMA Surg* 2013; **148**:145-150.

62. Peterhänsel C, Petroff D, Klinitzke G et al. Risk of completed suicide after bariatric surgery: a systematic review. *Obes Rev* 2013; **14**: 369–382.

63. Jans G, Matthes C, Bogaerts A et al. Maternal nutrient deficiencies and related adverse neonatal outcomes after bariatric surgery: a systematic review *Adv Nutr* 2015; **6**: 420-9.

64. Kominiarek MA. Pregnancy and Lactation after Bariatric Surgery. In: Kushner RF, Still CD, editors . Nutrition and bariatric surgery. 1st ed. Blackwell Publishing; 2014. ISBN 9781466557697

65. Aileen LL, Billett H. Obesity, bariatric surgery and iron deficiency: true, true, true and related. *Am J Hematol* 2008; **83 (5)**: 403–409

66. Jameson RL, Schneider JL. Wei Z et al. Proton pump inhibitor and histamine 2 receptor antagonist use and vitamin B12 deficiency. *JAMA* 2013; **310**: No. 22

67. Mohamed AH, Byrne CD. Bariatric surgery and renal function: a precarious balance between benefit and harm. *Nephrol Dial Transplant* 2010; **25(10)**:3142-7.

68. Woodcock S. BOMSS Primary care management of post-operative bariatric patients 2014 [Internet], London. Available from: http://www.bomss.org.uk/primary-care-management-of-post-operative-patients/ (accessed 8 Feb 2016).

69. British Association of Plastic, Reconstructive and Aesthetic Surgeons. Commissioning guide: Massive Weight Loss Body Contouring 2014. [Internet], London: Royal College of surgeons. Available from: http://www.bapras.org.uk/docs/default-source/commissioning-and-policy/body-contouring-surgery-commissioning-guide-published.pdf?sfvrsn=0 (accessed 20th February 2016).